unnecessarily prolonged, but in the majority the infection persisted and if the disease was not eventually eradicated by natural means, then late syphilitic manifestations were liable to occur.

The serum diagnosis of syphilis has demonstrated the inefficiency of mercurial treatment by internal administration. It has led to the discovery of the great tolerance which the intestine may acquire to this drug, so that after a time its only effect is to impair the nutrition of the patient. As Fordyce has stated: "Day after day we see patients the victims of paresis, tabes, etc., all giving identical therapeutic history of having had internal mercurial treatment for two or three years. The method stands condemned by its eloquent results."

It has shown the efficiency of treatment by salvarsan and neosalvarsan and also that combined with hypodermic injections of mercury salts; it is better than either alone. Although the hypodermic administration of mercurial preparations is greatly superior to internal treatment and may cause a very rapid disappearance of the external evidences of syphilis, yet only very slowly and often uncertainly, does it effect a cure, as judged by the frequent persistence of positive serum reactions.

With the aid of the Wassermann reaction syphilitic cases can be managed so that there is the least danger of relapses or the development of complications. It has therefore been one of the most important factors in the adoption of the present, earlier commenced, more rapidly effective, more certain, and more scientific methods of treatment.

DIAPHRAGMATIC HERNIA, WITH REPORT OF A CASE.

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Interest in diaphragmatic hernia has been greatly stimulated since the recognition of the condition has been so much facilitated by the development of Röntgen-ray technique. Although the lesion is not a remarkably rare one, until recently the diagnosis had but seldom been made, owing to the difficulty of correctly interpreting its physical signs. Grosser,[1] for example, in 1899, was able to collect records of 433 cases, but Arnsperger[2] makes the statement that up to 1908 the condition had been recognized during life in not more than 10 instances. Now, however, by means of radiography, intrathoracic conditions can be studied much more effectively, and it is possible not only to determine the presence of a diaphragmatic hernia with certainty, but in many instances to ascertain its exact nature. It is probable that the condition is much commoner than the number of published cases would lead one to suppose, for frequently, as in the case of the patient forming the subject of the present report, hernias of even the most extreme type give rise to no subjective symptoms and are revealed only as postmortem surprises should an autopsy be performed for some other reason.

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[1] Wien. klin. Woch., 1899, No. 24, p. 655.

[2] Deutsch. Arch. f. klin. Med., 1908, xciii, 88.

True diaphragmatic hernias, like those involving other portions of the abdominal parietes, consist of protrusions of abdominal viscera through congenital or acquired openings. The definition requires the presence of a sac, composed in this instance of a layer of peritoneum and one of pleura. Such protrusions, through the diaphragm, can take place either when one of the preformed foramina is abnormally wide from birth or gradually becomes so, or when, owing to deficiency or weakness of the muscle bundles, a weak spot exists through which the abdominal viscera can force themselves. This process is, of course, facilitated through the state of latent negative pressure constantly existing in the thorax. Accordingly, such protrusions of peritoneum forming a sac and passing through a hernial ring in an uninjured diaphragm are termed diaphragmatic hernias. It has been customary, however, to speak also of diaphragmatic hernia in those cases in which abdominal organs have entered the thorax through an actual aperture in the diaphragm, either natural or traumatic in nature. Under these conditions no real sac exists and the invading structures are free in the chest cavity, but the clinical manifestations are essentially similar and the term "false hernia" is applied. Diaphragmatic hernias may also be classified as congenital or acquired, and, finally, it is necessary to consider a condition clinically resembling a hernia and known as diaphragmatic eventration. In this, one-half of the diaphragm becomes greatly relaxed, so that the abdominal organs encroach upon the thoracic cavity and a hernia is simulated. The diaphragm remains intact, however, and there is no sac or hernial ring. Before discussing the symptomatology and diagnosis of these various conditions it will be well to go a little more into detail regarding the separate forms.

1. *False Congenital Diaphragmatic Hernia.* This is by far the commonest of all the diaphragmatic hernias, and according to Liepman[3] forms 87 per cent. of the congenital hernias. It results from imperfect development of the diaphragm, so that an opening of greater or less size permitting free communication between the thoracic and abdominal cavities exists from birth. In one case

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[3] Arch. f. Geburtshülfe, 1903, lxviii, 780.

reported by Klebs (Eppinger[4]) the diaphragm was totally absent, yet the child lived to the sixth year. Usually, however, the defect is much less extensive, and it is commonly situated on the left side. The opening is most often found in the space between the costal and lumbar portions of the diaphragm. Gössnitz[5] has shown by studies in comparative anatomy that this area is developmentally the last portion of the diaphragm to be closed, and he found that small defects invariably occur in this situation. The larger the opening, the greater is the involvement of the lateral and, finally, of the ventral areas of the costal portion of the diaphragm. In extreme cases almost the entire left half of the diaphragm may be missing, only a vestige of muscle extending from the sternum laterally to the chest wall. The various grades of congenital defect, therefore, may be regarded as different degrees of arrested development. Occasionally, however, defects originating in the sternal portion are seen, and the occurrence of several small sharply circumscribed openings in situations bearing no relation to the development or the anatomical structure of the organ has also been described.

The influences which are operative during intra-uterine life in impeding the normal closure of the diaphragm are not clear, and of the various theories advanced that of Laterjet and Jaricot[6] is perhaps the most plausible. They point out that the portion of the diaphragm that is the last to close is the most poorly vascularized, and that a slight degree of abnormal pressure here would suffice to cause nutritional disturbances leading to an arrest of development. The fact that the right side is almost never involved —Dietlen and Knierim,[7] in 1910, reported the first case of right-sided defect diagnosticated during life—lends color to the belief that the presence of the liver may serve in some sense as a protective agency in preventing disturbances of development.

2. *True Congenital Diaphragmatic Hernia.* This requires that a complete closure of the septum transversum shall have taken place, so that a true hernial sac is formed with a layer of peritoneum on the one side and one of pleura on the other. In other words, a congenital arrest of development occurring at a later period than in the preceding group leads to a thoracic protrusion of the most recently closed and, therefore, weakest portion of the membrane, before there has been a growth of muscle sufficient to resist the pressure. The sac is usually very large, invading a considerable portion of the thoracic cavity, and most often contains stomach and intestine, sometimes even portions of liver and pancreas.

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[4] Allgemeine und specielle Pathologie des Zwerchfells. Supplemente zu H. Nothnagel's Specielle Pathologie und Therapie. Wien und Leipzig, 1911. (Contains an elaborate chapter on diaphragmatic hernia and extensive bibliography.)

[5] Inaug. Dissert., Jena, 1903.

[6] Bibliographie anat., 1909, xviii, 22.

[7] Berl. klin. Woch., 1910, No. 25, p. 1174.

3. *True Acquired Diaphragmatic Hernia.* This consists of a protrusion of peritoneum through a hernial ring, which is formed either by the dilatation of one of the natural foramina, or, very rarely, by the giving way of a circumscribed weakened area acquired after birth. Hernias have been observed through Larrey's sternocostal space, through the triangular space described by Bochdalek, bounded by the outer lumbar crus, the adjoining costal portion, and the last rib, through the esophageal foramen, and through the opening for the sympathetic trunk. No hernia has yet been described as occurring through the aortic opening or that for the vena cava.

4. *Acquired Perforations of the Diaphragm* result not in true hernias but in a prolapse of abdominal viscera into the thorax, and so give rise to false traumatic hernias. They may be produced in two ways: either by penetrating stab or gunshot wounds, or by blunt violence causing rupture of the diaphragm. Of these, the former is far commoner; thus Iselin[8] found that of 90 cases 76 were due to stab wounds. The course in such cases is varied: death may follow in consequence of other complications, or closure of the opening through adhesions to neighboring organs may take place. Spontaneous closure of the opening is unlikely and the nonfatal cases usually end in chronic traumatic false hernia. The prognosis of operative closure by suture is good. Rupture of the diaphragm without external wounds may be caused by such injuries as being run over, falls from a height, crushing accidents, railroad buffer accidents, etc. Here again the left side is most affected, the proportion varying according to different authors from 15 to 1 to 4 to 1. Bell[9] has reported a case of long standing in which a nodule of liver with a constricted neck was found projecting through an old rent in the diaphragm apparently not due to an external perforating trauma.

In a third small group of cases rupture has been caused by violent vomiting. An instance of this is described by Daxenberger,[10] in which a man, aged twenty-three years, died sixteen hours after a violent vomiting attack. At the autopsy the stomach was found greatly dilated, owing to an old cicatricial stenosis of the pylorus, and was prolapsed through a fresh rent in the diaphragm. Perforation of the diaphragm due to suppurative processes such as subphrenic abscess, empyema, suppurative pericarditis, etc., seldom leads to hernia owing to the adhesions always present.

5. *True Atypical Traumatic Hernia.* This is a rare type, in which there is a true hernial sac, but the ring is not situated at one of the physiological openings. The protrusion takes place through a weakened spot in the diaphragm, which must still be covered

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[8] Deutsch. Zeitschr. f. Chir., 1907, No. 88, p. 150.

[9] Amer. Jour. Med. Sci., 1909, cxxxvii, 581.

[10] Münch. med. Woch., 1906, No. 7, p. 313.

with peritoneum. Schlatter,[11] in 1901, reported a case in which a stab only partly perforated the diaphragm and a hernia followed. Engel, Luksch, and Cruveilhier (Eppinger[12]) have described somewhat similar cases.

6. *Diaphragmatic Eventration, or Diffuse Relaxation of the Diaphragm.* This is not a hernia at all, but the differential diagnosis is often so difficult that the condition must be considered with the hernias. The relaxation of the diaphragm may be so extreme that its dome-shaped summit reaches the level of the second rib. It is practically always left-sided, and in 1910, Dietlen and Knierim[13] said that no instance of right-sided eventration had ever been reported, but Eppinger[14] has since then performed an autopsy on such a case. In consequence of the enormous dilatation the diaphragm naturally loses its muscular quality and becomes converted into a fibrous membrane, with occasional muscle bundles streaking inward from the periphery.

Although Laennec appears to have seen a case of this lesion, and it was Petit who gave it its name early in the last century, only 20 cases have been reported. Its pathogenesis is obscure and most authors assume a congenital predisposition, associated in some cases with degenerative changes in the muscle fibers. The liver seems to act as a protective barrier in preventing the occurrence of the relaxation on the right side. Partial relaxations involving only a portion of the left side of the diaphragm have also been described as diaphragmatic diverticula.

From what has been said it follows that the various lesions described may be classified as follows:

I. True hernias: (*A*) True congenital hernias in which pleura and peritoneum form the sac and only the muscular or tendinous layer of the diaphragm is absent. (*B*) True acquired hernias. (*a*) True typical acquired hernias with the ring originating at one of the natural foramina. (*b*) True atypical acquired hernias with the ring developing in a situation other than at one of the natural foramina.

II. False hernias: (*A*) Congenital false hernia through a congenital defect. (*B*) Acquired false hernia due to traumatic perforation of the diaphragm and either acute or chronic

III. Diaphragmatic eventration due to relaxation of the diaphragm and either involving an entire half of the diaphragm or localized in the form of a diverticulum.

DIAGNOSIS. It is almost inconceivable that extreme dislocation of organs that like the stomach and intestine are undergoing constant alterations in size can exist for years without giving rise to any subjective disturbances, yet such is the case and in many of the instances reported the abnormality has been revealed only at the autopsy. This, of course, is true especially of the congenital defects, which frequently give rise to symptoms only late in life, often as the result of apparently negligible inciting causes. Instances have been described in which the previously unsuspected condition was made manifest after dancing, exertion, exposure, or loss of flesh, but on the other hand, some of the patients have never been free from symptoms. Petit's patient, for example, died at the age of forty years after a history of constant attacks of vomiting, dyspnea, and pain, one of which finally ended fatally.

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[11] Münch. med. Woch., 1901, No. 48, p. 34.

[12] Loc. cit.

[13] Loc. cit.

[14] Loc. cit.

The physical signs in cases in which the hernia is large are usually significant and often conclusive. On the other hand, if the sac is small and centrally placed the diagnosis may be very difficult. The displacement of the heart to the right is very common and should always lead to the suspicion of some form of diaphragmatic hernia if the more usual causes of dextrocardia can be excluded. Since the hernial contents are always largely made up of stomach and intestine tympany can be elicited where normally there should be pulmonary resonance. The area over which it is heard varies at different times, or on changes of position in accordance with the variations in the amount or level of the contained fluid. The breath sounds are absent except at the edges of the area where the lung is in contact with hollow viscera and here there may be a metallic or amphoric quality to the respiratory murmur. Frequently gurgling sounds are present, similar to those heard on auscultating the abdomen. Succussion may be obtained at times, but it is characteristic of this as of other physical signs that it depends on the condition of distention with gas or fluid of the organs at the time of examination. Respiratory changes in the line of pulmonary resonance at the base behind, and Litten's diaphragm phenomenon may or may not be present depending on the mobility of what remains of the diaphragm. The affected side of the thorax is usually larger, the intercostal spaces are filled out, and there may even be respiratory protrusion between the ribs, especially in children. The patients frequently cannot lie on the healthy side because of the resulting cardiac distress, which as well as dyspnea and cyanosis may be brought on by very slight exertion. The abdomen may or may not be retracted, and if the spleen forms part of the protrusion its area of dulness will, of course, be absent. The stomach cannot be located in its usual situation by the customary methods of inflation, etc., and the sharp kinking of the esophagus makes the introduction of the stomach tube difficult or impossible. The same condition gives rise to the so-called dysphagia paradoxa, sometimes present, which consists in the fact that large masses of food are swallowed more readily than small well-chewed mouthfuls which cannot so well be pushed along by the distended esophagus. The displaced stomach usually swings about completely so that its greater curvature is uppermost, but there is great variability in the degree of the subjective gastric disturbance. Frequently a sensation of fulness and oppression in the thorax is complained of after eating.

Hematemesis is a common symptom, and may be due to congestion, incarceration, or ulcer. The thoracic dislocation of the colon may be ascertained by the changes in the physical signs following inflation or the administration of high enemas. Constipation is a common symptom.

Parasternal hernia is the commonest of the true hernias and occurs most often in stout middle-aged persons owing to the invasion of Larrey's space by adipose tissue. A significant sign of the lesion is a gurgling sound heard over the sternum synchronously with the heart beats. There may be a tympanitic quality to the percussion note in the same situation. Paraesophageal hernia is often accompanied by dysphagia, and the introduction of bougies into the stomach may be painful, difficult, or impossible. Eppinger[15] speaks of a ringing musical murmur accompanying the first heart sound as an important sign.

The most important feature in the examination is, of course, the use of the Röntgen ray, but it is necessary to make many examinations, at different times, in different positions, from different angles, and with and without the use of bismuth. Some authors, like Hirsch,[16] have found the pictures obtained after the introduction of a mercury-filled stomach tube especially significant. Giffin[17] emphasizes the obliteration of the distinctly dome-like outline of the normal diaphragm. Eventration and hernia through a large congenital defect, while anatomically totally different conditions, may clinically resemble each other so closely as to make the differential diagnosis extremely difficult or impossible. All the recent writers emphasize the value of radiography in distinguishing between the two. In eventration the shadow of the distended diaphragm is to be seen as a delicate line arching across the summit of the protruded mass of viscera, an appearance that is lacking in cases of hernia. Beltz[18] suggests that in difficult cases it may be possible to make the diaphragm shadow visible separately by slowly filling the stomach with air in different positions. A differential sign to which some authors attach importance is that if there is a defect of large size there is inspiratory elevation of the prolapsed viscera, while in eventration the fluoroscope shows an appearance approaching the normal inspiratory descent of the diaphragm. With the same idea in view, Hess and Jannin[19] suggest observing on the fluoroscope the effect of electrically stimulating the phrenic nerve, but adhesions between the viscera and diaphragm may make even this test unreliable. Eppinger,[20] indeed, comes to the conclusion that there is no single sign that can be accepted as positive evidence of eventration.

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[15] Loc. cit.

[16] Münch. med. Woch., 1900, No. 29, p. 996.

[17] Annals of Surgery, March, 1912.

[18] Münch. med. Woch., 1910, No. 19, p. 1006.

[19] Deutsch. med. Woch., 1906, No. 49, p. 1990; Verhandl. d. Kongr. f. innere Med., 1906, p. 359.

In the differential diagnosis such conditions as pneumothorax, subphrenic abscess, subphrenic pyopneumothorax, and esophageal diverticulum must be thought of and eliminated.

In spite of the usually large size of the ring, incarceration occurs in 15 per cent. of the cases. It is brought on by such conditions as torsion of the viscera, the taking of large quantities of food or fluids, increased intra-abdominal pressure caused by vomiting, straining at stool, or parturition, falls or abdominal contusions, etc. Or adhesions may form about the prolapsed viscera so that peristalsis is interfered with, giving rise to pain or other symptoms, and perhaps eventually to incarceration. Volvulus of the herniated intestine has also been known to occur. The symptoms are those usually seen in cases of incarceration at other hernial openings. If they appear in those previously suspected of having a diaphragmatic hernia, the diagnosis of hernia is confirmed, but when, as is sometimes the case, the incarceration is the first sign of any anomaly it may be a matter of much difficulty to ascertain the site of the lesion. Displacement of the heart to the right may give a clue, and the pain is said to be characteristic in that it extends through the chest with its point of maximum intensity below the hypochondrium, and is increased in inspiration. Girdle pain and dysphagia are sometimes observed. The intestinal obstruction may lead to distention of the abdomen or thorax, the latter, of course, being very significant. Dysphagia and hematemesis are common. Some patients give a history of numerous slight attacks of incarceration; others die of shock in the first attack, or from peritonitis following gangrene of the strangulated viscera.

It is difficult to be definite in speaking of the prognosis other than to say that in general it is that of all hernias, for even in cases in which there are no symptoms the menace of incarceration is always present. On the other hand the discovery at autopsy of a diaphragmatic hernia in an individual who never experienced any discomfort from the abnormality shows that in a certain number of cases the outlook is perfectly favorable. Patients in whom the existence of the condition is ascertained should be told of its nature and be warned of the possibility of incarceration. Eppinger[21] makes the suggestion that some generally understood symbol should be branded on the abdomen of such persons to serve as an indication to the surgeon who might at some future date be confronted with the puzzling picture of incarceration. In eventration the prospects are better, but even here intestinal obstruction may follow. In the traumatic cases the prognosis, of course, depends on the severity of the associated injuries, but any wound of the diaphragm, even if apparently not attended by immediately serious consequences, must be regarded as a matter of great gravity owing to the danger of subsequent incarceration.

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[20] Loc. cit.

[21] Loc. cit.

As far as treatment is concerned it may be stated of the traumatic hernias that as soon as the existence of a fresh wound of the diaphragm is ascertained immediate operation is indicated. The very prompt prolapse of the abdominal viscera makes spontaneous closure of the opening almost impossible. Iselin[22] found in 90 cases of operation for traumatic hernia collected from the literature that in 56 cases omentum or an abdominal organ presented in the external wound; and in 6 further cases abdominal contents were found in the thorax on opening the chest. In 64 left-sided cases there was omentum in the external wound 44 times, and 5 times in the pleural cavity, and in 5 instances stomach or intestine presented. In only 10 cases was there no prolapse. Prolapse of the omentum is especially important as it appears to be the first structure to enter the wound and then acts as a guide for the colon and stomach, thus favoring their prolapse. In a recent contribution Magula[23] from a study of 190 cases emphasizes the importance of immediate exploration in all cases of perforating wounds of the lower thorax or upper abdomen in order that a possible opening in the diaphragm may be promptly dealt with.

The prognosis is good when a prompt operation is performed, and according to Iselin the mortality depends only on the degree of injury to the gastro-intestinal tract. In non-operative cases the external wound may close and the patient apparently recover, but it is almost inevitable that sooner or later, often after years of freedom from symptoms, a hernia will develop. In operating most authors prefer the transthoracic route as affording better access to the wound in the diaphragm, but, on the other hand, while suture of the opening is more difficult from the abdomen, Iselin[24] points out that when approached from this side injuries to the stomach or intestine are less likely to be overlooked. In some cases the diaphragm was first sutured by enlarging the thoracic wound, and the abdomen then inspected through a laparotomy. The perils of pneumothorax are not considered grave, and at present can be rendered neglible by resort to one of the recent methods of differential pressure. Eppinger[25] found in 1911 that in 115 cases subjected to operation there were 17 deaths; that is, 14.7 per cent. Suter[26] in 1905, gave the mortality as 13.8 per cent., Iselin in 1907, as 16.6 per cent. Death in most cases was due to injuries to the stomach or intestine. In the sutured cases no subsequent hernia has been observed. In 6 cases of rupture of the diaphragm operated on, only 1 recovery was obtained, the deaths being due to the severity of the trauma or to infection.

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[22] Loc. cit.

[23] Arch. f. klin. Chir., 1910, xciii, 581.

[24] Loc. cit.

[25] Loc. cit.

[26] Bruns' Beiträge, 1905, No. 46, part 2.

In chronic hernias the treatment is entirely directed to the prophylaxis of incarceration by restricting the amounts of food and fluids taken at a time; anything likely to bring on vomiting must be avoided, constipation be guarded against, and pregnancy be prevented. Surgery is indicated only in case incarceration occurs. In cases developing shortly after a trauma the thoracic route is preferable, but in long-standing cases it is better to operate from the abdominal side as it is then easier to separate adhesions about the lower surface of the hernial opening. Carson and Huelsman,[27] however, have recently described a successful operation on a congenital hernia in which the seventh, eighth, and ninth ribs were resected.

The following case is a striking example of an extreme instance of congenital diaphragmatic hernia existing without subjective symptoms, death resulting from an independent lesion. The patient was admitted for a surgical condition in January, 1912, to the service of Dr. Abbe, at St. Luke's Hospital, to whom I am indebted for the opportunity of examining the bedside notes. The patient was a Scotchman, salesman, aged forty-seven years, who came to the hospital suffering from abdominal pain and other symptoms referable to a stenosis of the large intestine, with attending peritonitis, which ended fatally. The history included no symptoms that could be connected with the astonishing dislocation of the abdominal viscera which was revealed at the autopsy.

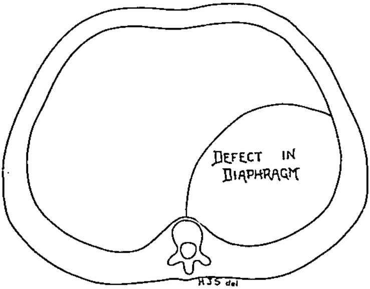

FIG. 1.—Diagram of the diaphragm seen from below, showing position and relative size of the defect.

AUTOPSY. The accompanying illustrations clearly indicate the relations of the displaced organs. On opening the thorax the

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[27] Interstate Medical Journal, April, 1912.

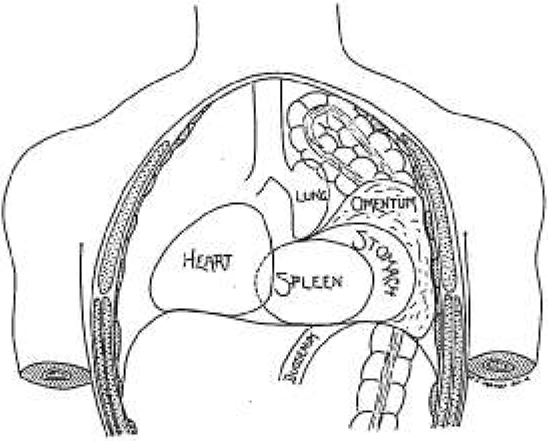

FIG. 2.—Diagram showing relations of the viscera as seen on opening the thorax.

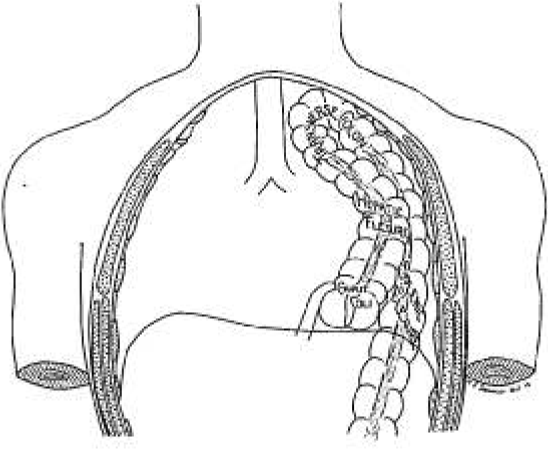

FIG. 3.—Diagram showing the general arrangement of the greatly distended coils of large intestine.

colon was seen occupying the left chest through a left-sided diaphragmatic defect. The spleen weighed 180 grams and was about in the position of the heart. The left lung was collapsed and measured 14 cm. in length, 7 cm. in width, and 2 cm. in thickness. The right lung presented numerous firm adhesions to the chest wall, but was otherwise normal. The left border of the heart was 2.5 cm. to the right of the median line, the right border, 11.5 cm. to the right of the median line, the upper border at the third rib, the apex at the sixth rib, 1.5 cm. inside the mammary line. The left chest was filled with omentum, caput coli, transverse and descending colon; a few inches of the ileum were lying above the diaphragm. The descending colon was straight and ran directly to the brim of the pelvis. The gut was much distended. The omentum was adherent to the transverse colon, making a sort of bag, but was not in any way adherent to the chest wall. The stomach lay above the diaphragm with the duodenum passing through the opening. The hernia could be easily reduced. The hernial opening occupied the posterior and lateral portions of the diaphragm, was about 15

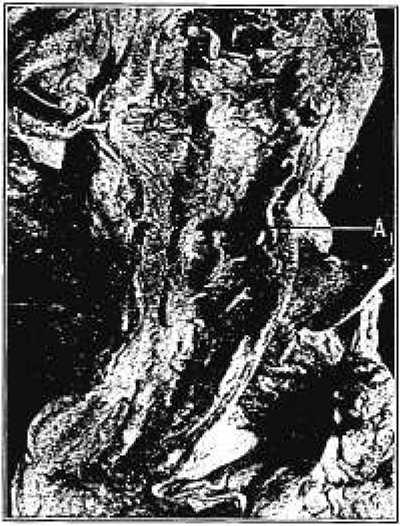

FIG. 4.—Photograph of the portion of the sigmoid stenosed as the result of diverticulitis, with the mouth of the largest pocket shown at *A*.

cm. in diameter, and had rounded and somewhat thickened edges. A loop of small intestine was adherent to the sigmoid at the brim of the pelvis. The sigmoid was constricted for a distance of 5 cm., so that even the little finger would not pass through the obstruction. The muscle was thickened above the constriction. The mucosa was practically normal except for four pockets with mouths 0.5 cm. in diameter. These pockets varied in depth from a few millimeters to several centimeters. There was a thick collar of firm inflammatory tissue some 12 cm. long about the sigmoid just above the pelvic brim, binding the gut down to the posterior abdominal wall. There was a band of fat and inflammatory tissue over the surface of the sigmoid, aiding in the constriction. The other organs presented no abnormalities.

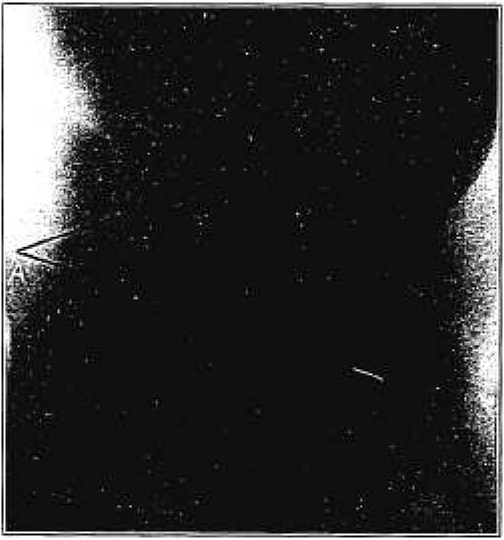

Fig. 5.—Bismuth radiograph showing at *A* the portion of the sigmoid stenosed as the result of diverticulitis.

Diagnosis: Perisigmoid inflammation (diverticulitis) with obstruction and beginning peritonitis. False congenital diaphragmatic hernia.

CONCLUSIONS. Diaphragmatic hernia is much commoner than generally supposed, and may exist indefinitely without giving rise to symptoms. Dextrocardia and physical signs suggesting those of pneumothorax should always cause the possibility of this condition to be thought of and lead to careful radiographic study of the thorax.

SOME CONSIDERATIONS REGARDING THE FACTOR OF FATIGUE, WITH REFERENCE TO INDUSTRIAL CONDITIONS.[1]

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WITHIN the past few years considerable literature has grown up with reference to the general subject of fatigue, and more recently it has been sought to utilize the results from the investigation of fatigue in helping to solve some of the industrial and occupational problems. While the mass of literature about these subjects is so large as to make any effort toward reviewing it at this time a practical impossibility, yet from it all there stand out certain general principles to which it is well worth while to call attention. There are certain other fairly well-accepted facts which belong within this same sphere, but which as yet have not received the recognition which is their due, to which attention also may be invited.

In the first place the problem of fatigue has been most thoroughly worked over with reference to the subject of muscular fatigue and with the use of the nerve-muscle apparatus. Here the problem has been a relatively simple one, and yet even with all its simplicity there remains a variety of questions to be answered, and the undisputed conclusions are few. It is generally admitted, as a result of this kind of work, that fatigue has two factors, a negative and a positive: the former the result of an actual wearing out of the used substance, in this case muscle, and the second the result of the formation of certain poisonous substances such as carbon dioxide, paralactic acid, and monopotassium phosphate. The term exhaustion has been proposed for this negative side of fatigue, while the word fatigue itself is used solely by some authors to indicate the positive side.

These results are results of the fatigue of muscle. The question of the fatigue of the nervous system is an entirely different one. As soon as an effort was made to define the actual place where

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[1] Read at the International Congress of Hygiene and Demography, Washington, D. C., September 23, 1912.